UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2004/2005
Second Semester Examination
2004/2005 Academic Session

Mac 2005
March 2005

ESA 254/3 – Isyarat Dan Sistem Elektronik Berdigit

Signal And Electronics Digital System

Masa : [3 jam]
Hour : [3 hours]

ARAHAN KEPADA CALON :
INSTRUCTION TO CANDIDATES:

Sila pastikan bahawa kertas soalan ini mengandungi **EMPAT BELAS (14)** mukasurat dan **LAPAN (8)** soalan sebelum anda memulakan peperiksaan.
*Please ensure that this paper contains **FOURTEEN (14)** printed pages and **EIGHT (8)** questions before you begin examination.*

Jawab **LIMA (5)** soalan sahaja. Rujuk kepada Jadual 1 dan 2 bagi **'Fourier Series and Fourier Transforms'**
*Answer **FIVE (5)** questions only. Refer to Table 1 and 2 for **Fourier Series and Fourier Transforms***

Calon perlu menjawab soalan dalam Bahasa Inggeris untuk soalan no. 1,2,3,4,5 dan jawab dalam Bahasa Malaysia untuk soalan no. 6 ,7, 8.
Student should answer questions in English for questions no. 1 ,2,3,4 5 and answer in Bahasa Malaysia for questions no. 6 ,7, 8.

Setiap soalan mestilah dimulakan pada mukasurat yang baru.
Each question must begin from a new page.

1. (a) Cari komponen ganjil dan genap untuk persamaan di bawah

$$x(t) = 1 + t\cos(t) + t^2\sin(t) + t^3\sin(t)\cos(t) + t^4\cos(t)$$

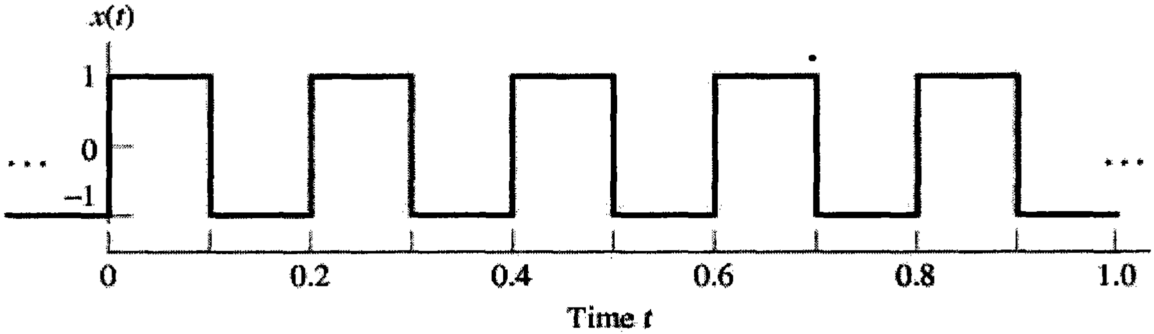
Find the even and odd components of the following

$$x(t) = 1 + t\cos(t) + t^2\sin(t) + t^3\sin(t)\cos(t) + t^4\cos(t)$$

(6 markah/*marks*)

(b) Apakah kuasa purata bagi gelombang segiempat di bawah

What is the average power of the square wave $x(t)$ shown below



(a)

(6 markah/*marks*)

(c) Cari sama ada sistem yang diberi

(i) kausal
(ii) songsang
(iii) tanpa ingatan
(iv) seimbang
(v) masa tak berubah
(vi) lelurus

$$y[n] = \left[\frac{n+4}{n+2.5}\right]^2 x(n)$$

$$y[n] = e^{nx[n]}$$

Find whether the given systems are

(i) *causal*
(ii) *invertible*
(iii) *memoryless*
(iv) *stable*
(v) *time invariant*
(vi) *linear*

$$y[n] = \left[\frac{n+4}{n+2.5}\right]^2 x(n)$$

$$y[n] = e^{nx[n]}$$

(8 markah/*marks*)

2. (a) Tunjukkan bahawa prinsip perlingkaran bagi dua fungsi pada masa domain adalah sama dengan pendaraban untuk dua fungsi dalam frekuensi domain.

Show from fundamentals that convolution of two functions in time domain is equivalent to multiplication of the two functions in frequency domain.

(4 markah/*marks*)

(b) Cari perlingkaran untuk fungsi masa selanjar berikut

$$x(t) = u(t-1) - u(t-3)$$

$$h(t) = u(t) - u(t-2)$$

Find the convolution of the given continuous time functions

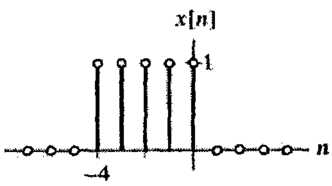
$$x(t) = u(t-1) - u(t-3)$$

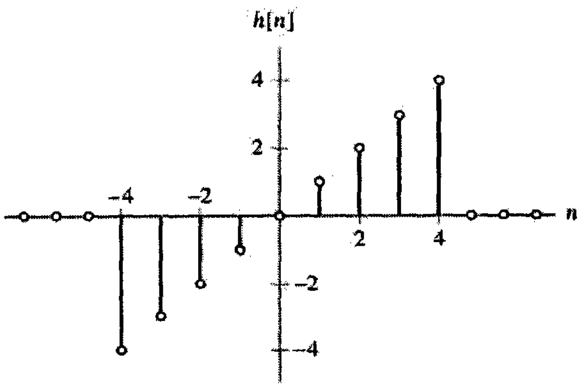
$$h(t) = u(t) - u(t-2)$$

(8 markah/*marks*)

(c) Cari perlingkaran untuk fungsi masa diskret yang diberikan

Find the convolution of the given discrete time functions



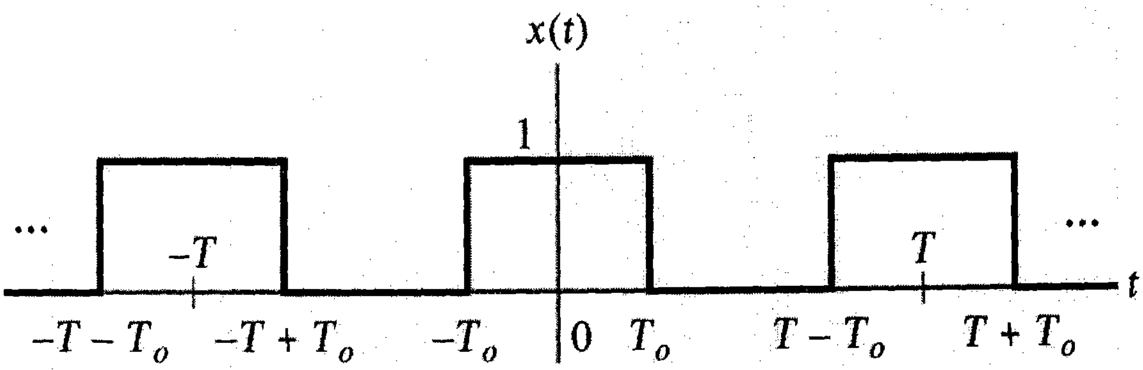


(8 markah/*marks*)

3. (a) Cari Jujukan Fourier untuk fungsi masa yang diberikan

Find the Fourier series of the given time domain function

(6 markah/*marks*)



(b) Apakah perbezaan ciri-ciri penjelmaan Fourier. Nyatakan dan buktikan ciri masa anjakan.

What are the different properties of Fourier transforms. State and prove time shifting property.

(6 markah/*marks*)

(c) Cari penyongsangan penjelmaan Fourier untuk fungsi di bawah

$$X(jw) = \frac{jw}{(1+jw)^2}$$

Find the Inverse Fourier transform of the following function

$$X(jw) = \frac{jw}{(1+jw)^2}$$

(8 markah/*marks*)

4. (a) Dengan menggunakan ciri berbilang, cari penjelmaan Fourier untuk persamaan di bawah

$$x(t) = \frac{d}{dt}\ (t\, e^{-2t} \sin(t)\ u(t))$$

Using multiple properties find the Fourier Transform of the following.

$$x(t) = \frac{d}{dt}\ (t\, e^{-2t} \sin(t)\ u(t))$$

(8 markah/*marks*)

(b) Lukiskan rekabentuk mikroprosesor 8085 dengan menunjukkan semua pendaftar dalaman dan terangkan fungsinya.

Draw the 8085 microprocessor architecture showing all the internal registers and explain their functions.

(6 markah/*marks*)

(c) Lukiskan gambarajah masa untuk arahan mikroprosesor 8085 MVIA OAH dan terangkan.

Draw the timing diagram for the following instruction of 8085 microprocessor MVIA OAH and explain.

(6 markah/*marks*)

5. (a) Tuliskan program bahasa pengumpul dengan menggunakan mikroprosesor 8085 untuk operasi tambahan bagi dua nombor persepuluhan yang di simpan pada lokasi ingatan 2200 H (85 D) dan 2201 H (44 D) dan simpan keputusan pada lokasi ingatan 2203 H.

Write an assembly language program using 8085 microprocessor for the addition of two decimal numbers stored in memory locations 2200 H (85 D) and 2201 H (44 D) and store the result in memory location 2203 H.

(10 markah/*marks*)

(b) Tuliskan program bahasa pengumpul dengan menggunakan 8085 mikroprosesor untuk mencari nombor yang paling kecil di dalam jujukan nombor yang di simpan pada lokasi ingatan 2201 H hingga 2205 H dan bilangan pada lokasi ingatan 2200 H. Nyatakan contoh dan simpan keputusan pada lokasi ingatan 2300 H.

Write an assembly language program using 8085 microprocessor for finding out the smallest number in a series of numbers stored in memory locations 2201 H to 2205 H and the count in memory location 2200 H. Give an example and store the result in memory location 2300 H.

(10 markah/*marks*)

6. (a) Lukiskan sebuah litar pensuisan dengan menggunakan simbol logik yang dapat menghasilkan operasi asas untuk:

   (i) Operasi OR
   (ii) Operasi AND

   ***Draw** a switching circuit using logic symbols that will perform the following basic operation*

   (i) OR operation
   (ii) AND operation

(2 markah/*marks*)

(b) Lukiskan rekabentuk litar pensuisan hasil dari fungsi F(X,Y,Z) yang berikut

   (i) $F(X,Y,Z) = X + X \bullet Y \bullet Z$
   (ii) $F(X,Y,Z) = X \bullet (X + Y + Z) + \overline{X}$
   (iii) $F(X,Y,Z) = \overline{X} + X \bullet Y + Z$

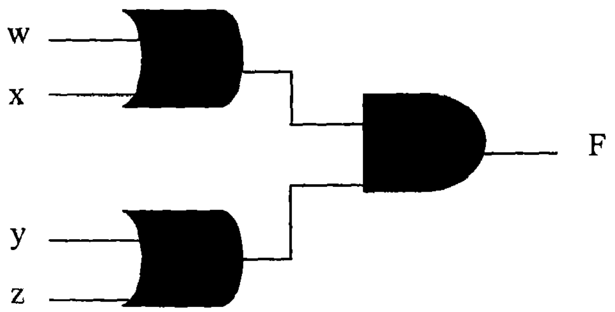
   ***Design** a switching circuit that will perform each of the following functions F(X,Y,Z)*

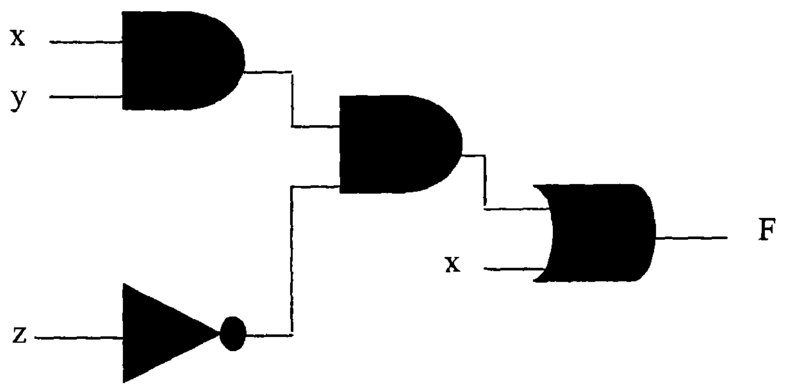
   (i) $F(X,Y,Z) = X + X \bullet Y \bullet Z$
   (ii) $F(X,Y,Z) = X \bullet (X + Y + Z) + \overline{X}$
   (iii) $F(X,Y,Z) = \overline{X} + X \bullet Y + Z$

(12 markah/*marks*)

(c) **Analisa** litar pensuis di bawah dan dapatkan ungkapan fungsi logik F dari setiap litar.

Analyze the switching circuit below and obtain the logic function of each circuit.





(6 markah/*marks*)

7. (a) Dengan mengunakan jadual kebenaran, tunjukkan:

$X + (Y + Z) = (X + Y) + Z$ (Associative theorem)

$X \bullet Y + \overline{X} \bullet Z + Y \bullet Z = X \bullet Y + \overline{X} \bullet Z$ (Consensus Theorem)

Using a truth table, show that

$X + (Y + Z) = (X + Y) + Z$ *(Associative theorem)*

$X \bullet Y + \overline{X} \bullet Z + Y \bullet Z = X \bullet Y + \overline{X} \bullet Z$ *(Consensus Theorem)*

(4 markah/*marks*)

(b) **Terangkan** operasi Penukar Analog Digital 4 bit dengan menggunakan sebuah lakaran. **Tentukan** kebezajelasan untuk sebuah ADC 8 bit yang input voltannya berada dalam julat 0 hingga 5 volt dan dengan output 8 bit.

***Explain** the operation of 4 bit Analog Digital Converter using a diagram. **Determine** the resolution for an 8 bit ADC with an analog voltage input range of 0 to 5 volts and an output with 8 bits.*

(10 markah/*marks*)

(c)

AB \ C	0	1
00	0	1
01	0	1
11	1	1
10	0	1

C \ AB	00	01	11	10
0	1	1	0	0
1	0	1	1	1

Ringkaskan setiap carta karnaugh di atas, dan tuliskan SOP minima dan ungkapan normal untuk setiap carta.

For each of the karnaugh map shown. Write the minimum SOP expression for each reduced map and each normal map.

(6 markah/*marks*)

8. (a) **Lakarkan** dan labelkan:

(i) Edge-triggered J-K flip flops
(ii) Edge-triggered D flip flop

***Draw** and label correctly:*

(i) Edge-triggered J-K flip flops
(ii) Edge-triggered D flip flop

(4 markah/*marks*)

(b) Lakar dan labelkan sebuah pengira penduaan 3 bit. Andaikan kesemua input J dan K adalah satu. Tuliskan jadual kebenaran untuk keluaran dengan berpandukan kiraan detik masa. Labelkan titik rujukan yang mana pengira kembali menunjukkan 0 0 0.

Draw and label a 3 bit binary counter. Assume all J and K inputs to be one. Write the truth table of the output with reference to the number of clock pulses. Label the point where the number counter resets to 0 0 0.

(10 markah/*marks*)

(c) Pengira di soalan 8(b) bermula di satah 000 sebelum detik denyutan dimulakan. Selepas beberapa denyutan, ia dihentikan dan pengira FF menunjukkan bacaan 0 0 1 1. Berapa detik denyutan telah berlaku? Huraikan samada pengira telah bermula semula atau tidak.

The counter in question 8(b) starts off in the 000 state and then clock pulses are applied. Sometime later the clock pulses are removed and the counter FFs read 0011. How many clock pulses have occurred? Discuss whether the counter has recycled or not.

(3 markah/*marks*)

(d) Sebuah pengira diperlukan untuk mengira bilangan bahan di atas tali sawat penyampai. Kombinasi sebuah sel foto dan sumber cahaya diperlukan untuk menghasilkan denyutan apabila terdapat bahan yang melaluinya. Pengira tersebut perlu menghitung sebanyak seribu bahan. Berapa FF yang diperlukan?

A counter is needed that will count the number of items passing on a conveyor belt. A photocell and light source combinations is used to generate a single pulse each time an item crosses its path. The counter has to be able to count one thousand items. How many FFs are required?

(3 markah/*marks*)

Table 1

Property	**Aperiodic Signal**	**Fourier transform**
	$x(t)$ $y(t)$	$X(j\omega)$ $Y(j\omega)$
Linearity	$Ax(t)+By(t)$	$AX(j\omega)+BY(j\omega)$
Time shifting	$x(t-t_0)$	$X(j\omega)e^{-j\omega t_0}$
Frequency shifting	$e^{j\omega_0 t}x(t)$	$X(j(\omega-\omega_0))$
Conjugation	$x^*(t)$	$X^*(-j\omega)$
Time reversal	$x(-t)$	$X(-j\omega)$
Time and frequency scaling	$x(at)$	$\frac{1}{\|a\|}X(\frac{j\omega}{a})$
Convolution	$x(t)*y(t)$	$X(j\omega)Y(j\omega)$
Multiplication	$x(t)y(t)$	$\frac{1}{2\pi}\int_{-\infty}^{+\infty}X(j\theta)Y(j(\omega-\theta))d\theta$
Differentiation in time	$\frac{dx(t)}{dt}$	$j\omega X(j\omega)$
Integration	$\int_{-\infty}^{t}x(t)dt$	$\frac{1}{j\omega}X(j\omega)+\pi X(0)\delta(\omega)$
Differentiation in frequency	$tx(t)$	$j\frac{d}{d\omega}X(j\omega)$
Conjugate symmetry For real signals	$x(t)$ real	$\begin{cases} X(j\omega)=X^*(-j\omega) \\ \mathrm{Re}\{X(j\omega)\}=\mathrm{Re}\{X(-j\omega)\} \\ \mathrm{Im}\{X(j\omega)\}=-\mathrm{Im}\{X(-j\omega)\} \\ \|X(j\omega)\|=\|X(-j\omega)\| \\ \angle X(j\omega)=-\angle X(-j\omega) \end{cases}$
Real and even signals	$x(t)$ real and even	$X(j\omega)$ real and even
Real and odd signals	$x(t)$ real and odd	$X(j\omega)$ purely imaginary and odd
Even-odd decomposition of real signals	$\begin{cases} x_e(t) & \mathrm{Even}\{x(t)\}[x(t)\text{ real}] \\ x_o(t) & \mathrm{Odd}\{x(t)\}[x(t)\text{ real}] \end{cases}$	$\mathrm{Re}\{X(j\omega)\}$ $j\mathrm{Im}\{X(j\omega)\}$
Parseval's relation for aperiodic signals $\int_{-\infty}^{+\infty}\|x(t)\|^2dt=\frac{1}{2\pi}\int_{-\infty}^{+\infty}\|X(j\omega)\|^2d\omega$		

Table 2

Table 2

Signal	Fourier transform	Fourier Series coefficients (if periodic)
$\sum_{k=-\infty}^{k=+\infty} c_k e^{jk\omega_0 t}$	$2\pi \sum_{k=-\infty}^{k=+\infty} c_k \delta(\omega - k\omega_0)$	c_k
$e^{j\omega_0 t}$	$2\pi\delta(\omega - \omega_0)$	$c_1 = 1$ $c_k = 0$, otherwise
$\cos\omega_0 t$	$\pi[\delta(\omega-\omega_0)+\delta(\omega+\omega_0)]$	$c_1 = c_{-1} = \frac{1}{2}$ $c_k = 0$, otherwise
$\sin\omega_0 t$	$\frac{\pi}{j}[\delta(\omega-\omega_0)-\delta(\omega+\omega_0)]$	$c_1 = -c_{-1} = \frac{1}{2j}$ $c_k = 0$, otherwise
$x(t) = 1$	$2\pi\delta(\omega)$	$c_0 = 1, c_k = 0, k \neq 0$ (This is the Fourier series representation for any choice of $T > 0$)
Periodic square wave $x(t) = \begin{cases} 1, & \lvert t\rvert < T_1 \\ 0, & T_1 < \lvert t\rvert \leq \frac{T}{2} \end{cases}$ and $x(t+T) = x(t)$	$\sum_{k=-\infty}^{k=+\infty} \frac{2\sin k\omega_0 T_1}{k}\delta(\omega - k\omega_0)$	$\frac{\omega_0 T_1}{\pi}\mathrm{sinc}(\frac{k\omega_0 T_1}{\pi}) = \frac{\sin k\omega_0 T_1}{k\pi}$
$\sum_{n=-\infty}^{n=+\infty} \delta(t - nT)$	$\frac{2\pi}{T}\sum_{k=-\infty}^{k=+\infty}\delta(\omega - \frac{2\pi k}{T})$	$c_k = \frac{1}{T}$ for all k
Rectangular pulse $x(t) = \begin{cases} 1, & \lvert t\rvert < T_1 \\ 0, & \lvert t\rvert > T_1 \end{cases}$	$\frac{2\sin\omega T_1}{\omega}$	
$\frac{\sin Wt}{\pi t}$	$X(j\omega) = \begin{cases} 1, & \lvert\omega\rvert < W \\ 0, & \lvert\omega\rvert > W \end{cases}$	
$\delta(t)$	1	
$u(t)$	$\frac{1}{j\omega} + \pi\delta(\omega)$	
$\delta(t - t_0)$	$e^{-j\omega t_0}$	
$e^{-at}u(t), \mathrm{Re}\{a\} > 0$	$\frac{1}{a + j\omega}$	
$te^{-at}u(t), \mathrm{Re}\{a\} > 0$	$\frac{1}{(a+j\omega)^2}$	
$\frac{t^{n-1}}{(n-1)!}e^{-at}u(t), \mathrm{Re}\{a\} > 0$	$\frac{1}{(a+j\omega)^n}$	

ooo000ooo